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PATENT

Atty Docket No.: 100203850-1
App. Ser. No.: 10/675,943

IN THE CLAIMS:

Please find a listing of the claims below, with the statuses of the claims shown in parentheses. This listing will replace all prior versions, and listings, of claims in the present application.

1. (Currently amended) An apparatus for processing a color image embodied in a computer readable medium, comprising:

an input processor configured to receive code for receiving the color image;

[[a]] code for Retinex-type processing processor, comprising:

a local statistics processor comprising a code for cascaded recursive filtering,

and

a point operation processor configured to code for correcting pixels of the input color image according to corresponding pixel values in the local statistics processor; and

an output processor configured to code for transforming the corrected pixels into an output signal that is indexed to represent an intensity of a particular position in the color image.

2. (Currently amended) The apparatus of claim 1, wherein the code for cascaded recursive filtering comprises [[is]] a cascade of filters of the form:

$$L_{i,j}^{SE} = \max \{ \alpha(\nabla_x S) \cdot L_{i-1} + (1 - \alpha(\nabla_x S)) \cdot S_{i,j}, \alpha(\nabla_y S) \cdot L_{j-1} + (1 - \alpha(\nabla_y S)) \cdot S_{i,j}, S_i \}, \text{ wherein } L \text{ represents illumination,}$$

$\alpha(\nabla S)$ is a scale independent parameter, S is the input color image, and ∇S is a scaled

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gradient, whereby SE above may be replaced by one of N, S, E, W, NE, NW, or SW according to standard compass notations corresponding to a direction of information flow.

3. (Currently amended) The apparatus of claim 2, wherein a parameter α of the cascaded recursive-filter is a function of an input signal of the color image.

4. (Original) The apparatus of claim 3, wherein the parameter α is a function of a local gradient ∇s , which returns a constant value α_0 for large ∇s values and decreases monotonically to zero as ∇s decreases.

5. (Original) The apparatus of claim 4, wherein $\alpha(\nabla s)$ is scale independent.

6. (Original) The apparatus of claim 5, wherein,

$$\alpha(\nabla S, \nabla_N S, N) = \begin{cases} \sqrt[N]{\alpha_0^{N_0}} & \nabla_N S \geq -T, \\ \sqrt[N]{\alpha_0^{N_0}} \cdot e^{\beta \min(\nabla S, 0)} & \nabla_N S < -T \end{cases}$$

wherein N is a size of the input image S, wherein $\nabla_N S$ is a scaled gradient, wherein T is a threshold value, and wherein β is a constant parameter.

7. (Previously presented) The apparatus of claim 6, wherein the scaled gradient of the color image is

$$\nabla_N S = \sum_{i=\Delta N+1}^{\Delta N} |S(i+j) - S(i+j-1)|$$

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8. (Cancelled).

9. (Previously presented) The apparatus of claim 2, wherein the scaled gradient of the color image is

$$\nabla_N S = S(i + \Delta_N^+) - S(i + \Delta_N^-)$$

where $\Delta_N^+ + \Delta_N^- = \left\lfloor \frac{N}{N_0} \right\rfloor$, and $\Delta_N^+ + 1 \geq \Delta_N^- \geq \Delta_N^+$.

10. (Currently amended) An apparatus for fast Retinex processing embodied in a computer readable medium, said apparatus comprising:

code comprising a robust recursive envelope operator for fast Retinex processing,
said operator having a cascaded recursive filter, wherein the cascaded recursive filter is used to calculate an illumination L at a particular position in an input image signal S using the following equation:

$$L_{i,j}^{xx} = \max \{ \alpha(\nabla_x S) \cdot L_{i-1,j} + (1 - \alpha(\nabla_x S)) \cdot S_{i,j}, \alpha(\nabla_y S) \cdot L_{i,j-1} + (1 - \alpha(\nabla_y S)) \cdot S_{i,j}, S_i \},$$

wherein ∇ is a gradient

function, $\alpha(\nabla S)$ comprises a scale independent parameter, wherein xx comprises a compass notation, and wherein the robust recursive envelope operator processes the input image signal S.

11. (Previously presented) The apparatus of claim 10, wherein α is a function of the input image S.

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12. (Previously presented) The apparatus of claim 11, wherein the function is a Huber function.

13. (Previously presented) The apparatus of claim 10, wherein α is a function of one or more parameters,

$$\alpha(\nabla S, \nabla_N S, N) = \begin{cases} \sqrt[N]{\alpha_0^{N_0}} & \nabla_N S \geq -T, \\ \sqrt[N]{\alpha_0^{N_0}} \cdot e^{\beta \cdot \min\{\nabla S, 0\}} & \nabla_N S < -T \end{cases}$$

wherein N is a size of the input image S, wherein $\nabla_N S$ is a scaled gradient, wherein T is a threshold value, and wherein β is a constant parameter.

14. (Previously presented) The apparatus of claim 10, wherein the compass notation is one or more of SE, SW, NE, NW, and wherein application of the cascaded recursive filter follows the compass notations.

15. (Cancelled).

16. (Currently amended) A computer readable storage medium on which is embedded one or more computer programs, said one or more computer programs implementing a method for processing an input image S, said one or more computer programs comprising a set of instructions for comprising:

producing an output illumination signal through application of the following equation:

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$$L_{i,j}^{SE} = \max \{ \alpha(\nabla_x S) \cdot L_{i-1,j} + (1 - \alpha(\nabla_x S)) \cdot S_{i,j}, \alpha(\nabla_y S) \cdot L_{i,j-1} + (1 - \alpha(\nabla_y S)) \cdot S_{i,j}, S_i \},$$

wherein L represents illumination,

$\alpha(\nabla S)$ is a scale independent parameter, and ∇ is a gradient function, whereby SE above may be replaced by one of N, S, E, W, NE, NW, or SW according to standard compass notations corresponding to a direction of information flow;

producing a reflectance signal from the output illumination signal;

transforming the reflectance signal into an output reflectance signal; and

outputting the output reflectance signal.

17. (Currently amended) The computer readable storage medium according to method of claim 16, wherein the parameter α is a function of an input signal of the image.

18. (Currently amended) The computer readable storage medium according to method of claim 17, wherein the parameter α is a function of a local gradient ∇s which returns a constant value α_0 for large ∇s values and decreases monotonically to 0 as ∇s decreases.

19. (Currently amended) The computer readable storage medium according to method of claim 16, wherein a $\alpha(\nabla s)$ is scale independent.

20. (Currently amended) The computer readable storage medium according to method of claim 19, wherein

$$\alpha(\nabla S, \nabla_N S, N) = \begin{cases} \sqrt[N]{\alpha_0^{N_0}} & \nabla_N S \geq -T, \\ \sqrt[N]{\alpha_0^{N_0}} \cdot e^{B \cdot \min\{\nabla S, 0\}} & \nabla_N S < -T \end{cases}$$

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wherein N is a size of the input image S, wherein $\nabla_N S$ is a scaled gradient, wherein T is a threshold value, and wherein β is a constant parameter.

21. (Currently amended) The computer readable storage medium according to method-of claim 20, wherein N_0 equals 256.

22. (Currently amended) The computer readable storage medium according to method-of claim 20, wherein applying the cascaded filter producing an output illumination signal further comprises sequentially applying a cascaded filter following a compass notation.

23. (Currently amended) The computer readable storage medium according to method-of claim 22, wherein the sequential application of the cascaded filter comprises SE, SW, NW, NE compass notations.

24. (Currently amended) The computer readable storage medium according to method-of claim 22, wherein the sequential application of the cascaded filter comprises more than four filters in cascade.